Space Weather Technical Forecast

Issued on Saturday, 28 May 2022 at 13:17 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales

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Space Weather Forecast Headline: Slight and reducing chance of M-class flares. G1/Minor Storms likely Day 1 (28 May), with slight chance of G2/Moderate Storms. Active electron fluence becoming likely by Days 3 and 4 (30-31 May).

Analysis of Space Weather Activity over past 24 hours
Solar Activity: Solar activity has been Low over the past 24 hours, with GOES16 recording occasional low-level C-class X-ray flares, with the background flux at B-class. There are currently four visible sunspot regions on the Earth-facing side, all of which are small and simple. AR3017 is no longer visible on the western limb, but it is still possible to see flares from this region. No Earth directed CMEs have been observed in coronagraph imagery in the last 24 hours, although a recent CME has yet to be analysed. This is unlikely to have a significant Earth directed component, however.

Solar Wind / Geomagnetic Activity: The solar wind, as observed by DSCOVR at L1, was indicative of a CIR and transition into HSS from CH84 or CH85. Wind speeds started around 350 km/s, rising to vary between 500-570 km/s after 28/0400 UTC. Density started above average, with peaks above 20ppcc, before gradually falling back to mostly average by 27/2000 UTC. The IMF, Bt, started strong with a peak of 18nT around 27/1220 UTC, before gradually easing to weak to moderate. The north-south component, Bz, ranged between +10/-16nT, gradually varying more weakly although mostly southward directed. The phi angle was mainly negative (towards the Sun). Geomagnetic activity was Unsettled to Active, with several G1/Minor Storm intervals after 28/0000 UTC.

Energetic Particles / Solar Radiation: The high energy proton flux (10 MeV) has been at Background levels through the last 24 hours. The high energy electron flux (greater than 2 MeV) was at moderate levels, with a peak value of 498pfu at 27/1325UTC, before declining to background from 27/1500 UTC. Corresponding electron fluence has remained well below the Active threshold (1e8 integrated pfu), with an earlier sharp decline, and 4.32e6 integrated pfu observed at 28/0000UTC.

Four-Day Space Weather Forecast Summary
Solar Activity: Solar activity is now expected to be mainly Low, with AR3017 rotating off the western limb. There is a slight and reducing chance of M-class flares through this period. There are no obvious bright flux regions over the eastern limb at present, and any increase in activity would therefore probably need to arise from development of the current quiet front side.

Solar Wind / Geomagnetic Activity: One CME features in the current forecast, that emitted on 25 May from the M1.3 flare from Ex-3016. This could potentially give a glancing blow during Day 1 (28 May), but may have missed Earth. The Earth is currently experiencing the fast wind from one or both of CH84/- or CH85/-. Elevated or slightly elevated wind speeds are likely to last into Day 3 (30 May), probably easing through Day 4 (31 May).
Geomagnetic activity is expected to be Unsettled to Active with further G1/Minor Storm intervals likely, and a slight chance of a G2/Moderate Storm interval if the CME does give a glancing

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blow. Geomagnetic activity should gradually ease to be mostly Quiet by Day 4.

Energetic Particles / Solar Radiation: The high energy proton flux (greater than 10 MeV) is expected to be at Background levels during this period, with a very slight and reducing chance of S1 due to AR3014 and AR3017 rotating well away from the west limb.
High energy electron flux (greater than 2MeV) is expected to remain at background levels initially, with a probable rise in response to the high speed stream(s) of CH84/- and/or CH85/-. The risk of reaching Active (1e8 integrated pfu) levels will rise into the new working week as the HSS and possibly CME effects wane.

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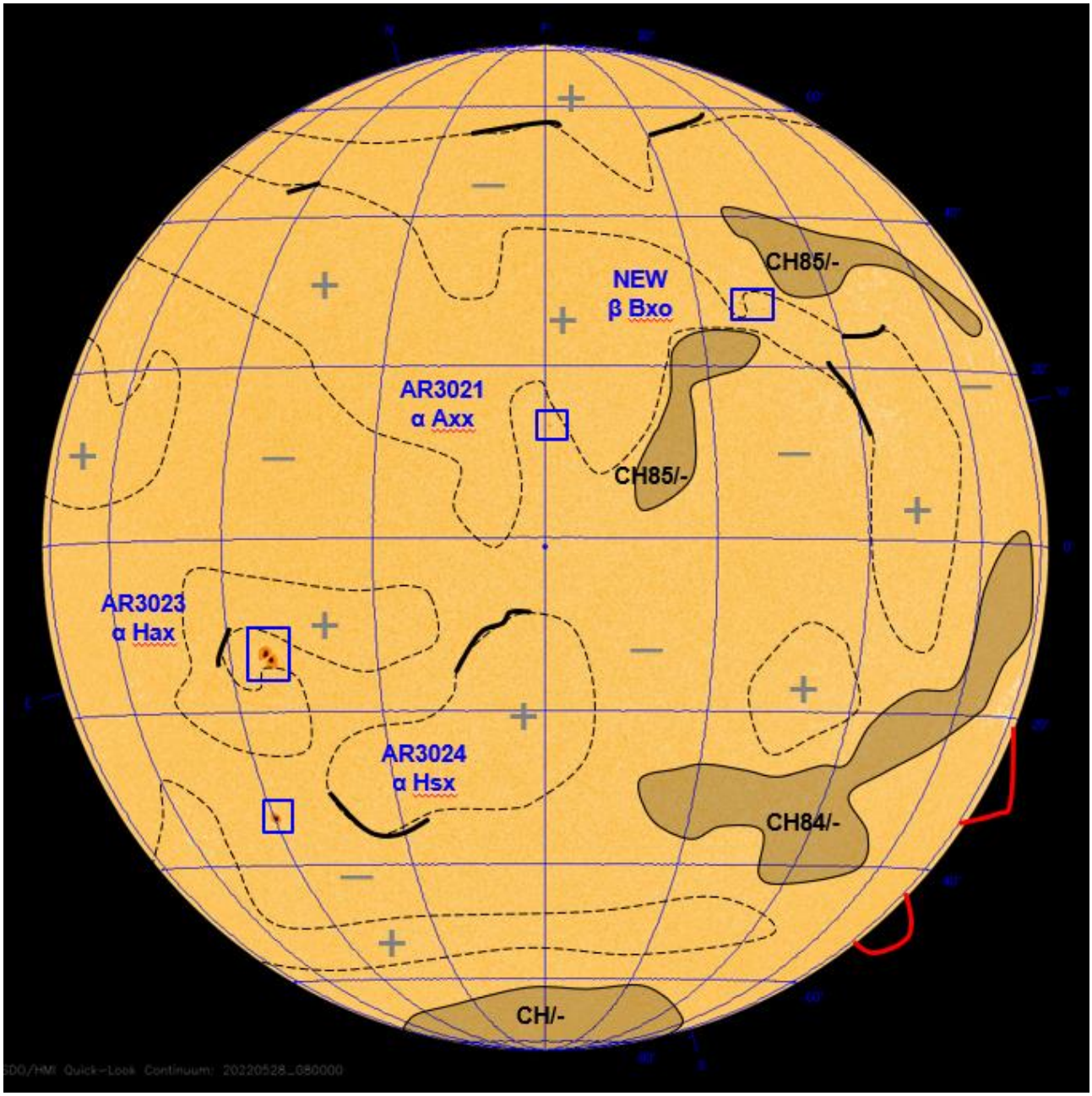
Figure 1. Solar Analysis Valid 28/0800 UTC.



Key: Filament ___ , Prominence ___ , Magnetic Field Line - - - , Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α-β-βγ-βγδ and Zurich-McIntosh Axx etc.

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Geomagnetic Storms:

One CME features in the current forecast, that emitted on 25 May from the M1.3 flare from Ex-3016. This CME could potentially give a glancing blow during Day 1 (28 May), but is now later than originally anticipated and may have missed Earth.

The Earth is currently experiencing the fast wind from one or both of coronal hole(s) CH84/- or CH85/-. These coronal holes extend a fair latitudinal distance across the western disc and as such elevated or slightly elevated wind speeds are likely to last into Day 3 (30 May), probably easing through Day 4 (31 May).

Geomagnetic activity is expected to be Unsettled to Active with further G1/Minor Storm intervals likely, and a slight chance of a G2/Moderate Storm interval if the CME does give a glancing blow. Geomagnetic activity should ease to be mostly Quiet to Active through Day 2, becoming largely Quiet by Day 4.

Geo-Magnetic Storm Probability (Exceedance)	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Minor or Moderate	G1 to G2	No	60	10	1	1
Strong	G3	No	2	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
25/2200	Partial	Ex-AR3016	20S 40W	1010 km/s	Early 28 May UTC	Glancing blow possible – may now have missed

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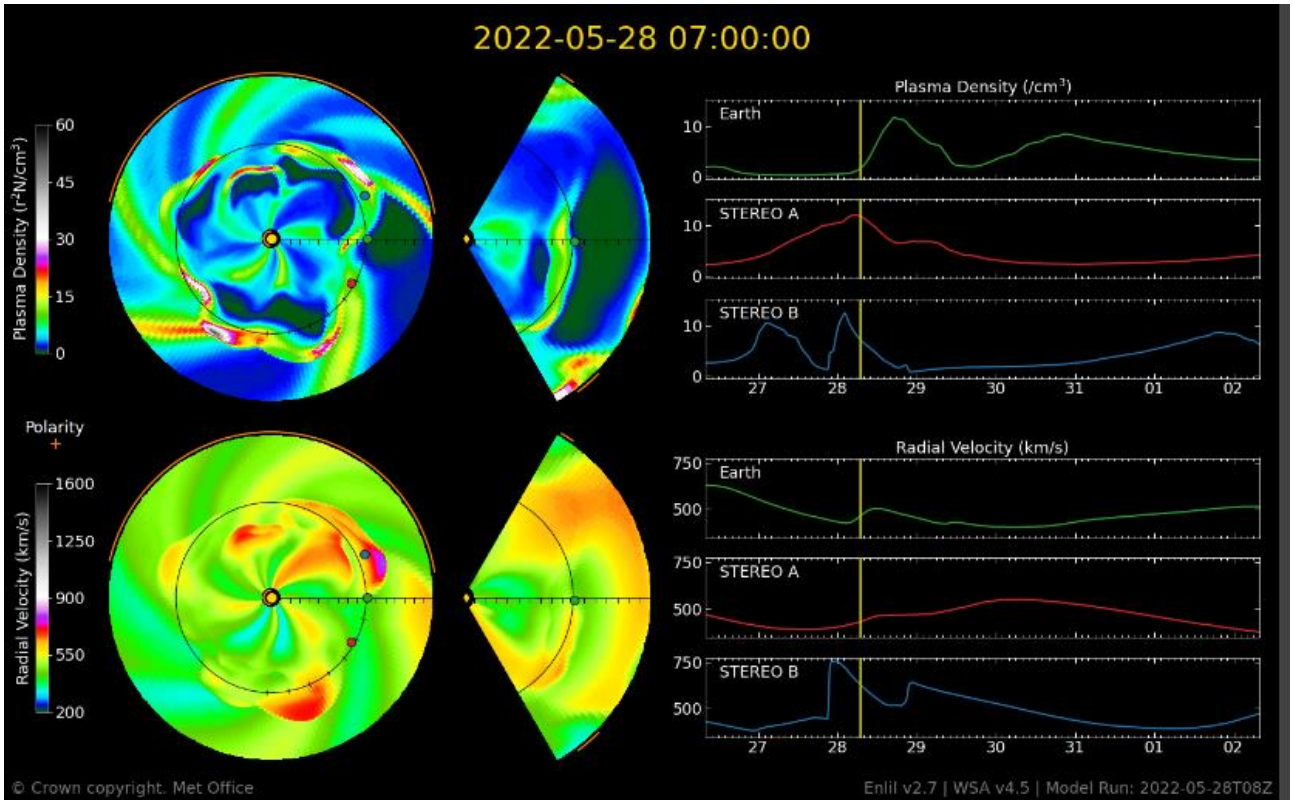
Figure 2: ENLIL model suggesting a possible glancing blow early on 28 May. This may now have missed Earth.



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Radio Blackouts - X-Ray Flares:

The visible regions on the disc are currently all small and simple with a low flare risk. AR3017 is no longer visible on the west limb, but will contribute a small amount to the flare risk until clear of the limb. As such, there is a slight chance of M-class flares, which reduces through Day 2 (29 May).

With no obvious returning regions due over the eastern limb in the coming four days, any rise in flare risk would need to be home-grown on the Earth-facing side.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	No	10	5	3	3
Very Active	R3 to R5 X Class	No	1	1	1	1

Solar Radiation Storms - (High Energy Protons):

The high energy proton flux (greater than 10 MeV) is at Background levels and is most likely to remain so through the period.
There is a very slight risk of increased proton flux, and solar radiation storms due to the location of AR3014 and AR3017 just over the western limb during day 1 (28th), but this risk reducing further day 2 onward (29th-31st) as they rotate well away from the visible disc.

Radiation Storms	Level (cm^{-2} sr^{-1} s^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	≥ S1	No	5	2	1	1
Very Active	≥ S3 *	No	1	1	1	1

* S3 ≥ 10 MeV ≥ 1000 pfu and / or ≥ 50 MeV ≥ 10 pfu. (pfu = $cm^{-2}sr^{-1}s^{-1}$)

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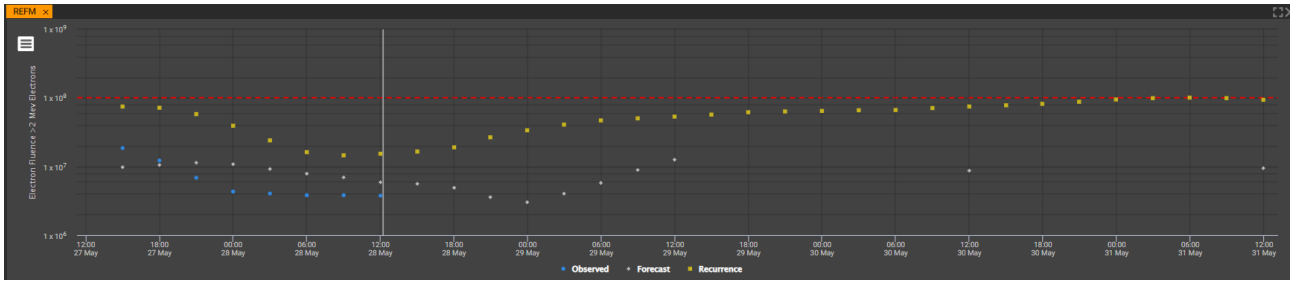
High Energy Electrons Event (≥ 2MeV):
The High energy electron flux (as measured by GOES-16) is currently at normal background levels. In the immediate term, flux levels are likely to be attenuated by geomagnetic activity from the fast wind(s) and possibly any CME glancing blow, with geomagnetic activity and wind speeds probably sufficient to compress the radiation belts and suppress electron counts at GEO through Days 1 and 2 (28 and 29 May). A gradual decompression of the radiation belts is likely through the later part of the period, with an increase in flux probable, assuming charging has occurred with the faster winds.

The chances of Active electron fluence should then increase into the new working week, with the magnitude of any response low confidence, but perhaps becoming likely to pass Active Day 3 (30 May) onward.

MOSWOC REFM's forecast is currently running counter to the expected evolution, likely because the recent rise in wind speeds has not yet fully been ingested into the model. Recent runs are starting to show an upward trend, so it is hoped that REFM will start to show a better trend in the near future. Persistence is offering a better guide in this respect, although the fact that the coronal holes differ between rotations and the fact there is a possible CME should mean that details differ. Persistence is likely indicating the upward trend too soon.

GEO Electron Environment Probability (Exceedance)	Level (cm^{-2} sr^{-1} day^{-1})	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC) (%)	Day 2 (00-24 UTC) (%)	Day 3 (00-24 UTC) (%)	Day 4 (00-24 UTC) (%)
Active	**≥ 2 MeV ≥ $1x10^8$**	No	1	30	60	60
Very Active	**≥ 2 MeV ≥ $1x10^9$**	No	1	1	1	1

Figure 3: REFM model starting to show an upward trend, although below the Active level. This may be a little too low.



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